

**DEVELOPMENT OF REMOTELY-CONTROLLED HOME MONITORING MOBILE
ROBOT WITH CAMERA FOR HUMAN AIDS**

HO CARL CHOON

**A report submitted in partial fulfillment of the requirements for the degree
of Bachelor of Mechatronics Engineering**

**Faculty of Electrical Engineering (FKE)
UNIVERSITI TEKNIKAL MALAYSIA MELAKA**

JUNE 2015

“ I hereby declare that I have read through this report entitle “ Development of Remotely-
Controlled Home Monitoring Mobile Robot with Camera for Human Aids” and found that it has
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Supervisor’s Name :

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Name :

Date :

ACKNOWLEDGEMENT

Firstly, I would like to thank my parents for supporting me throughout my final year by giving me motivation and courage to carry out my project. I am also grateful to my supervisors, Dr. Mariam Md Ghazaly and Engr. Mohd Rusdy bin Yacoob who have continuously lead us in achieving the goal of the project by giving meaningful and useful advice. Guidance from both supervisor have also teaches me to be responsible, analytical, and independent in order to acquire the highest achievement for the task that was given. Nevertheless, both supervisors have been working hard to assure that my project will be always be successful and functional by constantly providing updated technology information for my references. I would also like to thank my partner, David Chong from faculty FTMK, who has been working constantly with me to develop the virtual controller using Java source code. The knowledge that I learn from him have giving me a glimpse of taste on the developing a HTML page. Sharing of knowledge has allows me to excel in my project and even increase the understanding of each of the project where it should be the basic responsible of a Mechatronic Engineer. Finally, I would like to thank all my fellow friends who have help, assist and aid during the process of completing the project. I will always appreciate the useful time we spent together in solving the electrical problem or even troubleshooting. Thank you so much to all the people around me that had helped me either directly or indirectly in finishing my project.

ABSTRACT

Home monitoring system has been one of the basic infrastructure that will be installed in almost every residential compound in this modern world while closed-circuit television has become the trend replacing the security guard to look after their house 24 hours. However, closed-circuit television system which uses non-mobile video camera and wired system have created some limitation to the system such as limited angle rotation of camera which lead to creating blinds spot and high usage of wire. Thus, in this project we will develop a remotely-controlled home monitoring mobile robot system with obstacle avoidance property which provide more flexibility and mobility to the existing home monitoring system. Nevertheless, a modern networking system of local area network system (LAN) will be applied to the home monitoring mobile robot that enable user to control the robot from long distance wirelessly. To obtain a more optimal motor speed control, Pulse Width Modulation technique (PWM) is being used due to the simple operation method. Different combination of motor PWM will create different mobile robot turning angle while different surface condition and different steepness of slope will required different motor PWM to overcome. Performance of the mobile robot is tested in task 2 and task 3 with different parameter. However, the first task of this project is to analyse the sensitivity of IR sensor for developing the obstacle avoidance system. In task 2, the most suitable turning angle for the mobile robot to avoid the obstacle will be tested through experimental test. Task 3 is carried out to test the performance of mobile robot encountering different steepness of slope in working environment. The result from all the task have been collected and collaborated with each other to produce the final prototype which have a precise IR sensor obstacle avoidance system and able to operate at different conditions.

ABSTRAK

Sistem pemantauan kediaman merupakan salah satu infrastruktur yang akan digunakan di setiap kawasan perumahan pada masa yang akan datang apabila sistem CCTV telah menggantikan pengawal keselamatan untuk menjaga keselamatan rumah masing-masing. Sistem CCTV juga dikenali sebagai system pengawasan yang dapat memudahkan cara pengawasan rumah oleh pihak pengguna dengan menggunakan kamera video dan system rangkaian moden. Oleh sebab, kamera video merupakan barangan yang tidak mudah alih, dengan menggunakan hanya satu peranti pengguna tidak dapat meliputi keseluruhan kawasan kediaman melalui video tersebut. Walaupun menggabungkan lebih daripada satu peranti dapat meluaskan kawasan yang diliputi tetapi sudut putaran yang terhad akan melahirkan titik buta di kawasan seperti berdiri seranjang dengan video kamera tersebut. Oleh itu, projek ini akan membangunkan satu sistem pemantauan kediaman yang mempunyai sistem kawalan jauh dan juga satu system penggelakkan halangan. Selain itu, sistem rangkaian moden iaitu “local area network” (LAN) akan diimplikasi dalam system pemantauan kediaman ini. Teknik “pulse width modulation” (PWM) digunakan untuk mencapai kawalan kelajuan motor optimum oleh sebab Teknik ini mudah dipraktikkan. Tambahan pulak, kombinasi yang berbeza dalam PWM motor akan menghasilkan sudut beralih robot yang berlainan manakala permukaan yang berbeza dan perbezaan dalam kecerunan cerun hanya dapat diatasi menggunakan motor PWM yang berlainan. Prestasi robot beralih akan diuji melalui tugas 2 dan tugas 3 dengan menggunakan parameter yang berlainan. Walaubagaimanapun, tugas pertama projek ini ialah pengujian kepekaan IR sensor bagi melaksanakan sistem penggelakkan halangan. Dalam tugas 2, sudut beralih yang paling sesuai untuk robot beralih dalam meggelak halangan akan dicapai melalui ujian eksperimen. Tugas 3 akan menguji kepekaan robot beralih dalam segi melepasi kawasan yang mempunyai cerun yang berbeza. Dapatan yang diperolehi dari setiap tugas dapat menghasilkan prototaip yang terakhir yang mempunyai sistem penggelakkan halangan IR sensor dan dapat berfungsi dalam keadaan yang berbeza bagi projek ini.

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CHAPTER 1

INTRODUCTION

1.1 Problem Statement

Human beings are born to complete complicated and complex task in our daily life, unfortunately we as an individual always left-out those simple little task. Therefore, assist from technology are needed to help in those abandoned task. A remotely controlled mobile robot with camera is the best solution to our problems. Safety update and status update is also one of the feature that human being are craving for it. CCTV system is the only existing system in the market that could provide safety update and status update of a compound but mobility is one of the limitation for such system. One of the advantage of the remotely-controlled mobile robot with camera can provide the mobility that able to cover every corner of the particular floor level while preforming the safety and status update of the compound. However, mobile robot will sometimes become dented and spoiled after some knocks on the obstacle in its travel path. In order to overcome such problem, sensor will be installed on the body of the mobile robot to detect the surrounding obstacle so that there will always be a distance between the mobile robot and the surrounding obstacle.

1.2 Objectives

1. To analyse the sensitivity of the obstacle detection sensor so it can avoid the mobile robot from knocking on the surrounding obstacle.
2. To design and develop a remotely-controlled home monitoring robot with camera that can provide specific update to the user.
3. To design and develop a networking system that enable user to control the robot from long distance.
4. To analyse the performance of the motor so that it can provide enough power to travel on smooth and uneven surface.

1.3 Project Scope

The scope of this project is focused on producing a remotely-controlled house monitoring mobile robot with camera for human aids that provide live stream video and photo update to the user from long distance approximately 100m radius measuring from the Wi-Fi point. The mobile robot are designed to travel on slope and different surfaces such as sand road, tar road and carpet for a single floor coverage only. The project also concentrated on analysing the sensitivity of the obstacle detection sensor so it can avoid the mobile robot from knocking on the surrounding obstacle. As the sensor detected an obstacle within a certain range, the sensor will generate a signal and transferred to the microcontroller to notice the user to change travel path of the mobile robot. In order to achieve this target, the sensor must be placed at the edge of the robot so that an accurate reading can be collected.

1.4 Motivation

What are the advantages in introducing remotely-controlled home monitoring mobile robot with camera into our residential?

Perhaps this home monitoring mobile robot could be the solution to overcome the relative high property crime rate in our country. However, this home monitoring mobile robot are specifically designed to tackle the break in cases which falls under the category of property crime. Based on the crime index provided by malaysiakini.com, we have recorded a percentages of 19.7% of break in cases under the property crime category between January 2013 and September 2013 in 14 different state. 17,470 is the total number break in cases recorded within the 9 month period compared to 24,939 cases happen over the 12 month period in year 2012. ^[1] Back in the year of 2007/2008 we have collected data from annual police report listing that there are total of 123 of daytime and night time burglary cases in every 100,000 resident. ^[2] By looking at the figure, we may assume that most of the residential property in our country having a very low and unarmed security system and some even do not imply any security system in their house. Although there are many existing method in the market to overcome property crime and one of the most common system being used to tackle burglary cases is closed-circuit television (CCTV), also known as video surveillance. Unfortunately, such system does not slow down the crime index for break in cases due to several technical issue such as blind spot, immobility and high maintenance fee.^[3] Thus, we decided to produce a robot that may provide those disabilities of a CCTV system.

Remotely-controlled home monitoring mobile robot with camera is a complete package that combining the closed-circuit television system and mobile robot. Such combination has generated a new level of security system that can be the solution to the high rising property crime index. This system can be describe as a moving live camera than enable user to move around a certain compound to view the circumstances of their house. User may also some of the extra features of the system such as alarm trigger and photo or video capture to increase the security awareness. Being one of the victim of burglary crime, this has motivated me to complete and to share such useful system to each of the individual living in this modern world so that we may stand as one to reduce the burglary crime.

Crime index		
	2013 (Jan- Sept)	2012
Violent crime		
Murder	478	602
Rape	2,068	2,964
Armed gang robbery	78	110
Gang robbery	12,659	16,738
Armed robbery	17	17
Robbery	2,621	3,275
Assault	4,436	6,244
Property crime		
Robbery	16,258	24,299
Car theft	12,545	16,196
Motorcycle theft	37,081	51,259
Commercial vehicle theft	3,745	4,526
Snatch theft	1,564	2,500
Break in	17,470	24,939
Total	111,020	153,669

Source: Parliament
Azlan Zamhari / Malaysiakini

Crime index 2013 (January - September)														
	Selangor	KL	Johor	Sarawak	Kedah	Penang	Perak	N Sembilan	Sabah	Kalantan	Pahang	Malacca	Terengganu	Perlis
Violent crime														
Murder	124	45	71	42	18	25	39	18	45	18	16	13	4	-
Rape	293	105	336	102	188	94	120	128	177	166	146	83	101	29
Armed gang robbery	14	10	5	6	6	5	4	9	4	4	6	2	1	2
Gang robbery	4,583	3,420	1,369	201	451	631	625	525	185	99	211	270	72	17
Armed robbery	3	6	-	-	2	-	-	4	1	-	-	-	-	1
Robbery	638	905	242	77	83	125	102	106	76	45	52	102	64	4
Assault	868	567	533	336	305	274	299	347	209	232	177	108	117	64
Property crime														
Robbery	3,805	2,582	1,841	1,278	995	893	696	1,014	1,160	338	615	561	319	161
Car theft	4370	2,439	1,640	999	381	503	448	225	402	545	246	145	190	12
Motorcycle theft	9,698	4,181	5,080	2,332	2,731	2,533	2,161	1,009	703	1,918	1,619	1,302	1,587	227
Commercial vehicle theft	1,572	509	570	241	54	161	129	80	110	98	136	52	30	3
Snatch theft	698	156	18	145	120	137	113	6	43	43	33	9	23	20
Break in	5,682	1,859	1,465	1,164	1,090	815	849	1,054	1,287	684	670	525	245	81
Total	32,348	16,784	13,170	6,923	6,424	6,196	5,585	4,525	4,402	4,190	3,319	3,172	2,753	621

Source: Parliament
Azlan Zamhari / Malaysiakini

Figure 1.1: Evident of Crime Rate Statistic (break in) in 2013^[1].

1.5 Chapter Overview

In Chapter 1, Introduction, elements that will be covers in this chapter includes problem statement, objectives of the project, project scope and motivation to develop such project. This chapter generally introducing the background of my project.

In Chapter 2, Literature Review, elements that will be discuss in this chapter are literature introduction, component and device comparison literature conclusion and literature summary. Findings from journal which are relevant to my project will compared and analysed in order to decide the most suitable component to be used to develop my project.

In Chapter 3, Methodology, element such as project development plan, project timeline, project system operation, project process operation, prototype building, hardware used and experiment setup. Flow chart, table and figure will be used throughout the chapter to show the method used to develop my project in different aspect such as project management, prototype building and result finding.

In Chapter 4, Result and Discussion, all results and findings obtain from different experiment will be tabulated and presented in this chapter. Graph and raw data will be used to support the analysis made for each of the experiment conducted with different parameter tested. Findings from different experiment will require to achieve each of the objective set in the beginning of the project.

In Chapter 5, Conclusions and Recommendations, achievement of the project and recommendation on project future improvement will be discussed. Justification will be made to assure that each objectives are achieved and suggestion on improvement will be made to ensure the development of the project in near future.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

This chapter will discuss the review from previous research that is relevant to this final year project. There are some of researches that cover different part of the project such as remotely-controlled system, networking system, home monitoring, mobile robot and sensor. Most of the researches are being applied in different field, different application and different environment. Thus, each of the core element related to this project are discussed in this chapter.

2.2 REMOTELY-CONTROLLED SYSTEM




Remotely-controlled system is one of the advancement technology that have been practise in different field for different application. Remote control is described as a control of a system or activity by a person at a different location transmitting electrical signal wirelessly through radio frequency or ultrasonic signals.

Remotely-Controlled system have been tested in different application in engineering field. Previously, remotely controlled robot are mounted on construction machine such as backhoe, crawler dump and bulldozer to work in post-disaster recovery operation. The use of remotely controlled will allows workers to operate the machine from a safe distance to prevent the expansion of damage or secondary disaster [4]. Besides, remotely controlled

robot also being used for inspection work in nuclear power plant pipe and petrochemical complex pipe. Workers will not requires to risk working in a hazardous environment with the use of remotely controlled robot to complete the inspection work from long distance [5]. Furthermore, remotely controlled system also being applied ROTEX – the first remotely controlled robot in space. According to the research, ROTEX is suitable in performing manned mission for reducing dangerous extravehicular activities in space [6].

One of the most common application of remotely-controlled system in engineering field is mobile robot controlling. In order to setup a remotely-controlled system into a mobile robot a signal receiver and signal transmitter is require for signal transmission. There are several devices that provide such function such as Xbee module, Bluetooth module and GSM.

Table 2.1: Table of different devices for remotely controlled system.

No.	Devices	Signal transmission properties
1.	Xbee 	<ul style="list-style-type: none"> • Use radio frequency for data transmission. • Coverage: approximately 100m • Type of connection: Wireless
2.	Bluetooth 	<ul style="list-style-type: none"> • Use short wavelength UHF radio waves for data transmission. • Coverage: approximately 10m • Type of connection: Wireless
3.	GSM 	<ul style="list-style-type: none"> • Use mobile radio network for data transmission. • Coverage: Based on the coverage of the mobile network carrier. • Type of connection: Wireless